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Effects of Language Proficiency on Labour, Social and Health Outcomes of Immigrants in Australia

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Abstract

We investigate the causal effect of English proficiency on labour, social and health outcomes of immigrants in Australia. We use age at arrival combined with country of origin to form an instrument of English proficiency. We find that immigrants in Australia with better language proficiency are able to earn higher income, attain higher level of education, have higher probability of complete tertiary studies, and get more hours of work per week. Language proficiency also improves social integration, leading to higher probability of marriage to a native and higher probability of obtaining citizenship. We find only limited evidence with respect to the hypothesised causal relationship between language and health for immigrants. This last result may be due to small sample sizes.

Keywords: English proficiency, childhood immigrants

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Effects of language proficiency on labour, social and health outcomes of Australian immigrants

Abstract

We investigate the causal effect of English proficiency on labour, social and health outcomes of immigrants in Australia. Age at arrival combined with country of origin is used to form an instrument for English proficiency. We find that Australian immigrants with better language proficiency are able to earn higher incomes, attain higher levels of education, have a higher probability of completing tertiary studies, and are able to work more hours per week. Language proficiency is also shown to improve social integration, leading to higher probability of marriage to an Australian born resident (native)and higher probability of obtaining citizenship. We find only limited evidence with respect to the hypothesised causal relationship between language and health for immigrants. This last result may be due to the smallness of the surveys' sample size.

Keywords: English proficiency, childhood immigrants

I. Introduction

A large proportion of the Australian population are foreign-born: the latest estimate from the Australian Bureau of Statistics (ABS) indicates that 27%[4] were born overseas, one of the highest percentages in the world (ABS, 2011). This figure is higher than many other major countries that also have had a long history of immigration such as Canada, the United States and New Zealand[5].

The objectives of this study are to investigate the extent to which language ability influences immigrants' lives in a wide range of domains: labour market outcomes (e.g. income, employment, hours of work and education), social integration (e.g. marriage to a native, citizenship, and voluntary work), and health conditions (e.g. degree of health care access, and healthy lifestyle choices).

[4] This figure is valid as of 30, June 2010.

[5] 21.3% for Canada, 22.4% for New Zealand, 13% for the United States.

Early studies have used the ordinary least squares (OLS) methodological approach to analysing data on migrants. For example, McManus et al. (1983), Kossoudji (1988), Tainer (1988), Rivera-Batiz (1990), Chiswick (1991) and Dustmann (1994), have analysed how language ability, or the lack thereof, impacts employment status and income of immigrants in countries such as the United States and Germany. They generally found that the lack of host-country dominant language skills would constrain wage rates of those who are foreign-born, and that the wage gap between the natives and foreign-born narrows as immigrants attain more language skills.

As researchers began to take note of the potential biases produced by treating language skills as an exogenous variable in their estimation of the effects, many employed an instrumental variable approach. Some examples are Chiswick & Miller (1995), Angrist & Lavy (1997), Dustmann & van Soest (2002), Shields & Price (2002), Dustmann & Fabbri (2003), Bleakley & Chin (2004) and Bleakley & Chin (2010). The bias has been determined to be mainly due to measurement error, but there is also a possibility of unobserved non-language ability and reverse causality. These studies using instrument variable (IV) strategies have found a significant positive impact of proficiency on labour outcomes, but they also point out the bias of OLS estimates due to endogeneity.

In the present study we implement the empirical strategy proposed by Bleakley & Chin (2004, 2010). They used the fact that the age of arrival of migrants has a critical impact on their ability to learn the new language in order to identify the effect of English proficiency on market outcomes in the USA. The difficulty to learn a new language at a later age can be seen as providing a source of exogenous variation in language proficiency.

We use this same technique to study the causal effect of English proficiency on a range of outcomes of Australian immigrants. As in previous studies on migrants' proficiency we investigate labour market outcomes. We complement this study with an investigation of health outcomes on a smaller dataset. Whilst the evidence is less clear on the health data, to our knowledge it is the first such study and which therefore gives it some significance. To proceed, we used two datasets. For the labour market outcomes and social assimilation, data from the Australian 2006 Census are used, whilst data from the Australian National Health Surveys in 2001, 2004-5 and 2007-8 are used for the study on health outcomes. The demographic composition of the estimation samples consists of childhood immigrants — adult immigrants who arrived in Australia during their childhood along with their parents. This should not be confused with child immigrants who are currently still young.

The remainder of the paper is as follows. Section II presents the methodology, Section III describes the data used, Section IV presents the study of the effect of proficiency on labour market and social outcomes, Section V looks at effects on health outcomes and Section VI concludes.

II. Methodology

i. The issue of endogeneity

Following the recent works of Bleakley and Chin (2004, 2010), we have a model based upon a linear regression framework of the labour market outcomes y_{ija} of an individual *i*, who was born in the country *j* and who arrived in Australia at age *a*:

$$y_{ija} = \alpha + \beta ENG_{ija} + \delta_a + \gamma_j + \rho w_{ija} + \varepsilon_{ija} \quad (1)$$

where ENG_{ija} is a measure of English language skills, δ_a is a set of age-at-arrival dummies, γ_j is a set of country-of-birth dummies, and w_{ija} is vector of individual characteristics (i.e. age, age squared, and gender) and survey year dummies where applicable[6]. The coefficient β is the parameter of primary interest and represents the impact of English language skills on labour market success. However, obtaining consistent estimates of β is difficult because ENG_{ija} is likely to be endogenous and is likely to contain measurement error. Endogeneity and measurement error render ordinary least squares (OLS) estimates both biased and inconsistent, so any inference based upon those results is unreliable.

One potential source of endogeneity is omitted variables. For example, an individual's unobserved ability (e.g. intelligence, aptitude, etc) is likely to positively impact labour market outcomes, and also language proficiency. This correlation pattern would result in an upward bias in the least squares coefficient estimate for English proficiency. Another potential source of endogeneity could be reverse causality. That would occur if our outcomes of interest directly impact upon ENG_{ija}. Suppose y_{ija} is the amount of work in hours, it is possible that an individual acquires further language improvement due to close proximity with native speakers in a work environment.

Measurement error is also possible because the measure of language skills is likely to be composed of the unobserved true value and some noise. When estimating the gradient for the OLS regression, the effect of English skills will be diluted by the very existence of this noise to the extent of its variability. This is also known as attenuation bias. English ability is arguably difficult to measure precisely even when

[6] Survey year dummies are included for estimation that uses the National Health Surveys.

comprehensive tests are employed, so it would be expected that a simple self-reported answer in surveys or interviews contains substantial measurement error (Dustmann and Soest, 2002).

Since the omitted variables bias is upward and the attenuation bias is downward, the direction of the overall bias in the OLS estimate is difficult to ascertain a priori. However, Bleakley and Chin stated in their 2004 paper that the upward endogeneity bias in language skills is outweighed by the enormous downward attenuation bias. Using US national literacy test scores as the true value for English language skills, they verified the measurement error was indeed mostly classical, and that the IV estimate for the effect of English ability on earnings was higher than the OLS estimates. Likewise, Shields and Wheatley (2002) as well as Dustmann and Fabbri (2003) found downward bias in their OLS estimates. Similarly, given these results we would expect our OLS estimate is biased towards zero.

ii. The critical period hypothesis

The critical period hypothesis (CPH) postulates that there exists an optimal period early in life during which a person attains language skills more efficiently and effectively, and that if a new language is learnt during this period, an individual can exhibit native or native-like behaviour in their language usage when they are adults. But performance would start to deteriorate if exposure to the new language took place after the critical period, due to maturational constraints. The critical age generally lies between 6 and 12 depending on which part of language is concerned; it is earlier for certain linguistic features such as phonology, lexical and collocational abilities, but it is in mid-teens for morphology and syntax (Long, 2005). The decline is usually linear and gradual, towards a lower ultimate attainment or asymptote (Newport, 2001).

The deterioration in proficiency appears to be related to the decline in neural plasticity in the brain as it matures. Newport et al. (2001) summarised the results from five studies from 1996 and 1997 finding that, with the exception of two studies, the way in which the neural network is organised varies more for late-learned languages, than for the native language. This implies that the brain learns a language more or less universally before the critical age, after which the ultimate attainment, on average, is lower and is different from person to person depending on their experience.

Although the precise biological mechanism through which language acquisition takes place is still uncertain and accepting that the CPH is not without controversy (Birdsong, 2006, Newport, 2001), fairly strong evidence supports the notion of a critical period in phonological and grammatical aspects of language learning (Newport, 2001). Moreover, a recent study by Long (2005) evaluated a broad array of papers that were critical of the CPH on empirical grounds and found nine problems with the alleged counter-evidence.

The debate may persist concerning whether a certain aspect of CPH is valid or not, but for the purpose of this research, absolute consensus of the CPH is not necessary, as merely knowing that there is an age effect on language acquisition is adequate. Simply put, the relevance of the age at arrival variable used

as part of an instrument does not rely upon the specific interpretations of the CPH on which researchers so often diverge in opinions. Rather it relies on the empirical basis behind the notion that native-like proficiency is typically achieved prior to a certain age.

iii. Instrument for English proficiency

The CPH can be used to build an instrument for English proficiency. Considered is the following first stage equation where English proficiency is the dependent variable for an individual *i*, who was born in country *j* and who arrived in Australia at age *a*:

$$ENG_{ija} = \alpha_1 + \pi_1 z_{ija} + \delta_{1a} + \gamma_{1j} + \rho_1 w_{ija} + \varepsilon_{1ija} \qquad (2)$$

The variable z_{ija} is an exogenous instrument, δ_{1a} is a set of age-at-arrival dummies, γ_{1j} is a set of country-of-birth dummies, and w_{ija} is a vector of individual characteristics (i.e. age, age squared, and gender) and survey year dummies where applicable. The instrument z_{ija} is defined as the interaction effects between the age at which immigrants arrived in Australia and whether they originally came from an English-speaking country:

$$z_{ija} = \max(0, a - \theta) \times I(j \text{ is a non-English-speaking country}) \qquad (3)$$

where *a* is age at arrival, θ is the critical age, $I(\cdot)$ is the indicator function, and *j* is country of birth.

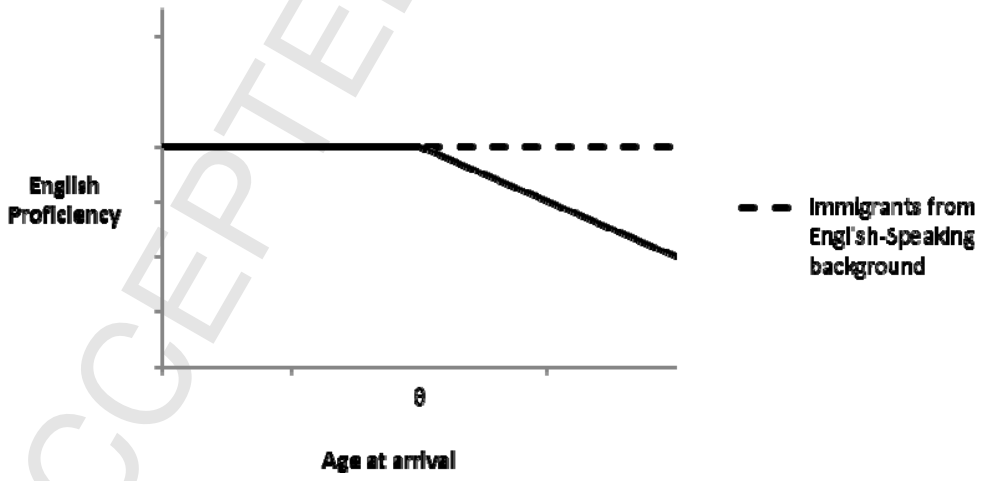


Figure 1: A graphic illustration of the instrument

A restriction is imposed that there is no difference in language ability between non-native-speaker immigrants who arrived before the critical age and native-speaker immigrants regardless of their age of

arrival; but after such age θ, the formers' language ability declines in a linear fashion, as is shown in Figure 1. Thus, the age effect on language acquisition based upon the CPH is readily encapsulated. After estimating our full sample first stage equation (2) where English speaking ability is regressed upon age at arrival and other exogenous variables, the value for θ is determined to be 10 based on the highest F statistic testing whether the coefficient estimate of age at arrival is equal to zero.

If a breakpoint is known, a Chow test can be used to determine whether there is a structural break in the sample. Given our uncertainty over where, exactly, the critical age of language acquisition lies, it is necessary to employ the Quandt Likelihood Ratio (QLR) test which is defined as the maximum of all the Chow test statistics over a selected range of possible values for the unknown breakpoint. As we have the opportunity to experiment with a range of values for θ, the critical values for a typical Chow test cannot be used; rather, the appropriate critical values for the QLR test are available in a study done by Andrews (2003). The QLR test statistic takes the following form:

$$\text{QLR statistic} = \max [F(\theta_0), F(\theta_0+1), F(\theta_0+2), ..., F(\theta_1-2), F(\theta_1-1), F(\theta_1)] \quad (4)$$

where F(.) is the Chow F-statistic for the breakpoint θ such that θ is between θ_0 and θ_1.

The following equation is constructed for testing for the structural break, with a dummy variable I_{ija} derived from $I(\cdot)$ in equation (3) indicating whether j is a non-English-speaking country; $d_{\vartheta ia}$ is a dummy indicating whether the individual's age-at-arrival is strictly greater than θ. Thus:

$$ENG_{ija} = \mu_0 + \mu_1 a_{ij} + \mu_2 I_{ija} + \mu_3 a_{ij} I_{ija} + \mu_4 d_{\vartheta ia} + \mu_5 d_{\vartheta ia} a_{ij} + \mu_6 d_{\vartheta ia} I_{ija} + \mu_7 d_{\vartheta ia} a_{ij} I_{ija} + \gamma_{2j} + \rho_2 w_{ija} + \varepsilon_{2ija} \quad (5)$$

where z_{ija} is our exogenous instrument, a_{ij} is the individual's age-at-arrival, γ_{2j} is a set of country-of-birth dummies, and w_{ija} is a vector of individual characteristics (i.e. age, age squared, and gender) and survey year dummies where applicable[7].

The first and last 25% of age at arrival are not considered potential values for the critical age. θ_0 and θ_1 are chosen to be 4 and 12 respectively, as they lie in the middle 50% of the range. Chow statistics are computed after estimating the regression in eq. (5) for each potential breakpoint. The null hypothesis is $\mu_4 = \mu_5 = \mu_6 = \mu_7 = 0$; the 1% critical value for four restrictions and the chosen range of possible breakpoints, is 19.47. The resulting QLR statistic is largest at 112.52 when θ = 10. In other words, the critical age is

[7] Survey year dummies are included for estimation that uses the National Health Surveys.

determined to be at ten. This is consistent with the graphical illustration of such relationship in section IV and V; this critical age also yields the highest F-statistics for the instrument in the first stage estimation.

For our instrument to satisfy the exogeneity assumption, we require it to affect labour market success y_{ija} only through its effect on English proficiency ENG_{ija}. With the inclusion of the age at arrival dummy variables and country-of-birth dummy variables, we believe this assumption is satisfied. The age at arrival dummy variables capture the acquisition of important skills other than language (e.g. Australian culture, social norms and education system) and the country dummy variables capture the other non-language aspects of cultural and institutional differences across countries.

In fact, because of the country and age dummies, this first-stage can be interpreted as a classic difference in difference (DiD) equation, where the differences in English ability between early and later arrivals from a non-Anglophone country are compared with the difference in English ability between early and later arrivals from an Anglophone country. The Anglophone immigrants can be thought of as the control group while the non-Anglophone immigrants can be thought of as the treatment group. For example, suppose that there are four Australian immigrants who arrived during childhood; persons A and B from Canada (control group) and persons C and D from China (treatment group). Immigrants A and C are early arrivals who came to Australia at the age of five while immigrants B and D are late arrivals who came to the country at the age of 15. The immigrants from the control group learned to speak English before arrival, therefore regardless of age at arrival, be it five or 15, they should have native proficiency. On the other hand, the immigrants from the treatment group only learned English after arrival, so their age at arrival greatly determines their English ability. The difference between A and B's English ability is non-existent, yet the difference between C and D is the age effects on language.

III. Data

i. Australian Census 2006

We use the Confidentialised Unit Record File (CURF) Microdata, derived from the Australian Census of Population and Housing 2006.[8] The 5% expanded version of the dataset contains individual-level, family-level, as well as household-level information, in which there are 391,893 households, 418,340 families and 1,002,793 persons. Geographical representation was also ensured in the construction of this dataset (ABS, 2009b). Moreover, the household-level and family-level identifiers have enabled us to match wives and

[8] The Australian Census 2011 data was not available when the research was conducted.

husbands who are living in the same dwelling, in order to determine whether or not an immigrant is married to someone who was born in Australia.

Our selected sample contains childhood immigrants who are Australian residents born outside of Australia. In order to avoid including self-selected overseas students who later became permanent residents or citizens, only persons who arrived in Australia (age at arrival) with their family at 16 years of age or earlier are included. For eliminating potential biases caused by retirement, only immigrants whose age is between 25 and 60 are included in the sample for every employment related estimation. Consequently, the length of residence in Australia is between 11 years and 51 years. In addition, we have dropped those people with missing information on education levels, English speaking ability, Australian citizenship status and voluntary work for an organisation or group, as well as dropping attending full-time or part-time students from the sample. That leaves us with a main sample of 32,578 individuals. Of the 32,578 observations, 2,082 are living in the same household as another immigrant in the sample. These are likely to be either partners who both came to Australia at a young age or relatives such as siblings with similar migration circumstances. Unfortunately, it is not possible to add family fixed effects in our empirical model given the limited number of clusters at the household level and limited amount of variation within these clusters.

Given no information is available from the Census dataset on an individual's personal weekly income only full time workers were included to better reflect the effects of English proficiency on income that was earned rather than through other sources. The sample size for this income variable is therefore more than halved with 13,969 observations due to the aforementioned restriction as well as the exclusion of negative or nil income values that have been reported by respondents.

Employment related models, namely whether they are employed; whether they are employed full-time; and their hours of work per week, are estimated using a smaller sample of 27,067 where the self-employed and those with missing labour force status are also excluded. 7,773 of them worked less than 1 hour per week. Information for hours of work is given as hourly from 6 hours to 59 hours. The mid-point is inputted if the value is between 1 and 5 hours. 60 hours or more is truncated to 60.

The age at arrival variable is defined as year of arrival minus year of birth. Year of birth is calculated by subtracting their age from the year 2006. Because year of arrival is given in five-year intervals from years 1955 to 2000, we decided to use the most recent year of each interval as their year of arrival so that a maximum possible age[9] at arrival for each person ensues. For instance, individuals who arrived in 1955 or before are coded as 1955; individuals who arrived between 1956 and 1960 are coded as 1960. An overstated

[9] This is the same approach as in Bleakley & Chin's 2004 and 2010 papers.

value, rather than an average value of age at arrival ensures migrants who came because of their own decision are excluded in the sample. Such observations would render our instrument endogenous because the decision to immigrate would no longer be independently made by their parents. It is worthwhile to point out that caution needs to be taken when interpreting results since someone who has an age at arrival of 10 could have arrived in Australia at an age as early as 6. The same principle also applies to the interpretation of the critical age θ.

An ordinal measure of proficiency in spoken English is created using four responses to the question "How well does the person speak English?"; with 0 being "Not at all", 1 being "Not well", 2 being "Well" and 3 being "Very well". Since this question was only applicable to persons who speak a language other than English at home, we assume that persons who speak only English at home can speak it "very well". Thus, data was coded accordingly and handled the same way as earlier studies that used a similar question from the US census counterpart to study English proficiency such as Bleakley & Chin, 2004 (2004); Bleakley & Chin, (2010); and Chiswick & Miller, (1995).

For educational attainment, values range from 8 to 17 years. 8 denotes grade 8 or below; 9 denotes grade 9 and so forth if the person has that particular school level. Post-secondary school qualifications are added on top of those school years, where a certificate is considered an additional year; advanced diploma or diploma two additional years; a Bachelor degree three additional years; a Graduate diploma or certificate four additional years; and other postgraduate degrees five extra years. Individuals who have completed some tertiary studies are those with a certificate level or above.

As individual weekly income is recorded in ten brackets of various interval amounts the mid-point of each bracket is subsequently taken for computation. For example, the mid-point of AUD$75 is entered for the income bracket AUD$1-AUD149, and at the other end $2000 is entered for the bracket AUD$2000 or more. Afterwards, the natural logarithms of these income amounts are calculated to generate log personal weekly income for each individual.

We have retained most of the available country-of-birth information from the dataset; nonetheless, several country/region categories are combined into geographically comparable groups due to their small sample size, and others are no longer present after all the sample restrictions are made. This results in the construction of 32 country-of-birth dummies. We further divide these countries/regions into two categories based on whether English is the everyday language spoken by a significant portion of the population. New Zealand, England, Scotland, United States of America, South Africa, other United Kingdom or Ireland, and other Northern America are defined as English-speaking countries; the remainder is codified as non-English-speaking countries. The former can be thought of as the control group while the latter as the treatment group.

ii. National Health Surveys 2001, 04-05 & 07-08

We use the National Health Surveys (NHS) conducted in 2001, 2004-05 and 2007-08 for the study of health outcomes. These three releases of data contain health as well as demographic details of 26,863, 25,906 and 20,788 persons; 17,918, 19,501 and 15,792 households in the 2001, 2004-05 and 2007-08 surveys respectively, resulting in a total of 73,557 persons and 53,211 households. While these surveys are "..the same or similar in many ways…" (ABS, 2009a), a number of characteristics are quite dissimilar and hence care has been put into the selection and manipulation of data ensuring the resultant pooled data is suitable for estimation purposes. Marked differences span across aspects including sample design and coverage, survey methodology, content, definitions, classification and so forth. Examples of changes include computer-assisted-interviewing questionnaires in 2004-05 and 2007-08 versus pen and paper questionnaires in 2001; while interviewers were employed to administer the questionnaires to participants, adult women were given an additional self-completion questionnaire in regards to women's health issues in the 2001 NHS; removal and addition of topics. Further details about these changes can be found in the user's guides of NHS 2004-05 and 2007-08.

Our selected sample only contains childhood immigrants who are Australian residents born outside of Australia. In order to avoid sample inclusion of overseas students who made their own choice in coming to Australia to study and later became permanent residents or citizens, only immigrants whose age is 25 or above in the survey year and whose age at arrival with their parents is 16 or earlier are included. The resulting length of residence in Australia is between 10 years and 53 years across the three surveys. In addition, five observations are dropped because of unknown information about their private health insurance and regular skin examination status. We are left with a main sample of 3195 individuals. A number of variables are constructed in the same fashion as with the Australian Census, including age at arrival, years of education, an English proficiency measure and personal weekly income.

With the broader classification of country of origin, only 11 country-of-birth dummy variables are generated. New Zealand and the United Kingdom are the only English-speaking countries (apart from of Australia) that can be identified in these datasets and are categorised as such, whereas the rest are regarded as non-English-speaking countries. Fortunately, Australia, New Zealand, the UK and Ireland constitute more than 99% of respondents from the main English-speaking countries according to the 2001 NHS version 2 correction file.

Self-assessed health score measures the level of general health reported by the individual. There are five possible responses; poor, fair, good, very good and excellent. The values assigned for each level of physical wellbeing go from 1 to 5; with 1 being poor while with 5 being excellent. Kessler Psychological Distress Scale (K10) is a measure generated from a set of ten questions asked about negative emotional states in the four weeks prior to the interview, ranging from 10 to 50 with a higher number indicating higher

level of psychological distress. This score can also be used as a quick screening procedure for depressive and/or anxiety disorders due to its high sensitivity and specificity (ABS, 2003). Furthermore, despite slightly different cut-off points and interpretations of each cut-off range by various organisations, the classifications are generally similar with any score above 30 regarded as very high on the scale of distress or likely to have a severe mental disorder. Long term conditions are medical conditions that have lasted or are expected to last six months or more for the respondent. This variable is coded in integers up to five with upper truncation.

With respect to the variables that are related to the amount of heath care access, visits to GP are the number of times an individual consulted with a general practitioner in the previous fortnight and visits to specialist are the number of times the individual consulted with a medical specialist during that same period. Since data on long-term conditions, visits to GP and visits to specialist are not available in the 2007-08 NHS, there are only 2,212 observations for the three variables. Regular skin check provide information on whether the respondent undertakes regular medical examination for any changes in freckles and moles. Private health insurance is whether the respondent at the time of survey had private health insurance coverage. Its duration is coded using mid-points; 0.5 years for periods less than one year, 1.5 years for periods between one and two years, 3.5 for periods between two and five years, and five years for any longer periods.

In terms of immigrant's lifestyle choices, variables of interest include whether they are current smokers, how much alcohol they consume on a daily basis, and the number of times moderate exercise was undertaken during the last two weeks. Daily alcohol intake is derived from taking the average amount over the three most recent drinking days. The units in which daily alcohol intake is measured are standard drinks. A standard drink contains 12.5 ml of pure alcohol; a 375 ml can of 5% beer for example is equivalent to 1.5 standard drinks. The first health survey reports this information in groups of 10 ml so the mid-points are taken for each interval, whereas the second and third health surveys are more precise as to present data continuously except for values above 100. And similarly for the amount of moderate exercise, the middle points are entered for each interval for the 2001 NHS: 0 for none, 1.5 for one to two times, 4.5 for three to six times, 10.5 for seven to 14 times, and 15 for the rest. However, the values for this variable are reported individually from 0 to 14, with 15 or above truncated to 15, in both 2004-05 and 2007-08 NHS. In order to utilise all three datasets for these two variables, this is accepted as an unavoidable compromise.

IV. Labour market, education and social outcomes

i. Descriptive statistics

Table 1: Summary statistics of the Census data

	Total (1)		Very well (2)		Well/not well/ Not at all (3)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
English-speaking ability	2.959	0.222				
Non-English-speaking country	0.528	0.499	0.510	0.500	0.987**	0.115
Instrument Z	0.608	1.494	0.523	1.384	2.836**	2.328
Outcome variables:						
Log personal weekly income	6.900	0.456	6.910	0.454	6.655**	0.458
Employed	0.741	0.438	0.747	0.434	0.584**	0.493
Employed full-time	0.525	0.499	0.527	0.499	0.453**	0.498
Hours of work	27.217	20.084	27.425	20.038	21.704**	20.532
Married to an Australian-born	0.334	0.471	0.344	0.475	0.060**	0.238
Married	0.576	0.494	0.577	0.494	0.548*	0.498
Citizen	0.815	0.388	0.812	0.391	0.911**	0.285
Voluntary work	0.180	0.384	0.184	0.387	0.085**	0.278
Completed tertiary education	0.556	0.497	0.564	0.496	0.350**	0.477
Control variables:						
Age	42.981	9.995	43.090	9.952	40.113**	10.695
Age at arrival	8.451	4.173	8.325	4.124	11.770**	4.091
Male	0.508	0.500	0.509	0.500	0.501	0.500
Years of education	12.252	2.250	12.289	2.236	11.286**	2.421
Number of observations	32578		31385		1193	

Note: * denotes significant difference in means at the 1% level compared to the "very well" category; ** denotes significant difference in means at the 5% level. Full-time is defined as at least 35 hours of work per week as defined by the ABS.

Table 1 provides the descriptive statistics for the entire sample and the sub-samples when split into the two proficiency levels – individuals who spoke English "very well" and those who did not. For the purpose

of illustration, the three lower fluency levels are combined into one. It should also be noted that the majority of the whole sample is made up of "very well" spoken people because the question in regard to their English skills was not applicable to people who only spoke English at home, and few people reported "not well" or "not at all" due to the fact that our selected group of individuals immigrated to Australia at such early ages. There are only 136 and 8 observations in the "not well" and "not at all" categories respectively. As a consequence, the coefficient estimates of our models most likely reflect the identification of the effects through the higher fluency levels - that is, "well" and "very well" - rather than the lower fluency levels. Not surprisingly then, the mean of English-speaking ability is 2.959 which is very close to the maximum possible value of 3.

There is a statistically significant difference between the two language ability groups across all variables except gender. Immigrants with the highest proficiency, on average, have higher weekly incomes, more hours of work; more likely to be employed, employed full-time, married to an Australian-born native, an Australian citizen, and involved in voluntary work. They are also more likely to be married, but only at the 5% level of significance. Close to 99% of people who reported their English proficiency as below "very well" originated from a non-Anglophone country, in contrast to only 51% of people whose proficiency in English was "very well" and who had a non-Anglophone background. On average, not only does the more fluent group have higher personal weekly incomes, a higher proportion of employment, a higher proportion of full-time employment, more hours of work per week, an earlier age at arrival, and more years of education; they also are more likely to be married, more likely to be married to an Australian-born, and more likely to be involved in voluntary work. Nevertheless, the fraction of the very fluent individuals who have obtained Australian citizenship is less than that of the less fluent individuals.

Figure 2: Means of English proficiency measure

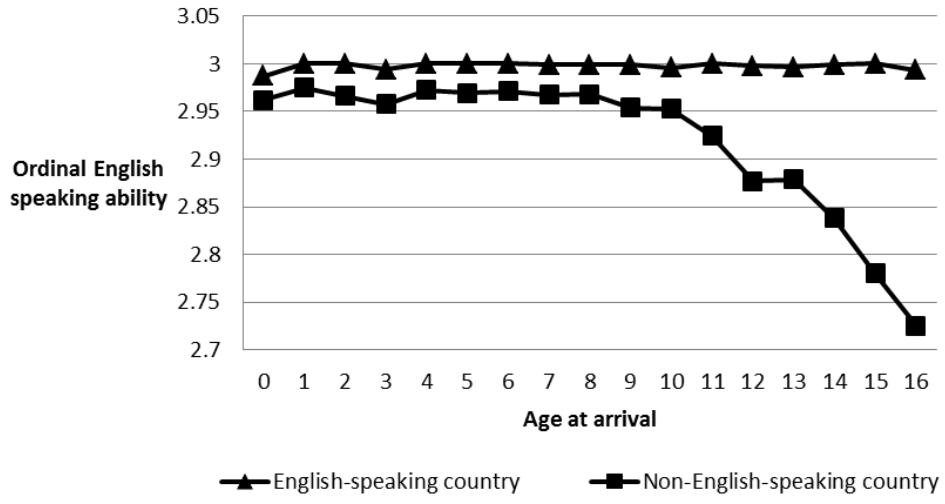


Figure 2 shows a graphic comparison of the average English proficiency of immigrants who are from an English-speaking country and that of immigrants who are from a non-English-speaking country. The shapes of the relationships look almost identical to the graphs presented in Bleakley and Chin's 2004 and 2010 studies as can be expected from the critical period theory on language acquisition.

ii. Results

The estimates from the first stage equation (available in the supporting information material) are useful for checking the validity of IV specification. When estimating the effect of our instrument z_{ija} on English proficiency, we found a highly significant effect of the instrument ($p<0.001$). This is in line with Bleakley and Chin's results. It indicates that z_{ija} is not a weak instrument.

Table 2 displays the effects of English proficiency on labour market and education outcomes, using four different estimation techniques. The results show that English speaking ability has a strong impact on immigrants' income, hours of work, and education. The direction of these results is positive as expected. The 2SLS estimates are all larger than the OLS estimates, except for full-time employment, confirming that the downward attenuation bias does indeed outweigh the upward ability bias as mentioned by other papers.

The language effects on both income and years of education for immigrants in Australia are not dissimilar to what Bleakley and Chin (2004) obtained for the immigrants in America. Coincidentally, their OLS estimate on wages is identical to ours. According to our two state least squares (2SLS) result, it is found that one ordinal unit increase in English language ability, for instance, from "well" to "very well", raises personal weekly income by 112%[10], in comparison to an increase of 40% in the US study. Conversely, the 2SLS coefficient estimate for years of education is 2.4 in our study, which is smaller than the estimate of 4 for US immigrants.

Table 2: Effect of English proficiency on labour market outcomes and education

	OLS		2SLS		IV probit/IV Tobit#	
Dependent variable	(1)		(2)		(3)	
Full sample						
Log personal weekly income	0.222***	(0.023)	0.751***	(0.185)		
Employed	0.147***	(0.013)	0.197**	(0.087)	0.168*	(0.090)
Employed full-time	0.099***	(0.013)	0.085	(0.096)	0.101	(0.108)

[10] The percentage change for the dependent variable can be obtained in a log-linear model by subtracting the antilog of the coefficient (0.751) from 1, with other explanatory variables being held constant.

Hours of work (with zeros)	5.317***	(0.558)	5.492	(3.878)	5.986*	(3.274)
Years of education	1.290***	(0.055)	2.394***	(0.402)		
Completed tertiary education	0.217***	(0.012)	0.403***	(0.093)	0.449***	(0.095)
Only males						
Log personal weekly income	0.218***	(0.031)	0.716***	(0.237)		
Employed	0.105***	(0.019)	0.220	(0.140)	0.186	(0.144)
Employed full-time	0.113***	(0.020)	0.106	(0.168)	0.078	(0.174)
Hours of work (with zeros)	5.118***	(0.850)	5.539	(6.983)	6.222	(6.349)
Years of education	1.252***	(0.077)	3.042***	(0.680)		
Completed tertiary education	0.217***	(0.018)	0.607***	(0.158)	0.610***	(0.149)
Only females						
Log personal weekly income	0.218***	(0.035)	0.804***	(0.304)		
Employed	0.181***	(0.018)	0.172	(0.111)	0.166	(0.114)
Employed full-time	0.090***	(0.017)	0.080	(0.114)	0.101	(0.118)
Hours of work (with zeros)	5.599***	(0.715)	5.606	(4.502)	5.499	(3.527)
Years of Education	1.300***	(0.075)	1.936***	(0.479)		
Completed tertiary education	0.212***	(0.015)	0.240**	(0.110)	0.329***	(0.120)

*** denotes significance at the 1 % level, ** denotes significance at the 5% level, * denotes significance at the 10% level. # IV Tobit specification is used for the hours of work outcome, whereas IV probit specification is used for the other outcomes, and both IV Tobit and IV probit results are marginal effects. Robust standard errors adjusted for household clusters are shown in parentheses. Each row displays a coefficient estimate of the effect of English proficiency on a different dependent variable.

On the one hand, English language skills are a determinant of whether an immigrant is employed or not; 2LSLS and IV probit results indicate that an improvement in English speaking ability increases the probability of employment by 17% to 20%. On the other hand, when the dependent variable is whether the immigrant is employed full-time instead, the estimates are substantially smaller in size, and the 2SLS and IV probit figures are no longer statistically significant. This could mean that part-time employment could be the driving force of this relationship.

Given the dependent variable, hours of work, has a large number of zeros for those who are either unemployed, or not in the workforce, IV Tobit is appropriate to eliminate the bias caused by the censored variable. As shown in Table 2, the standard IV estimate is statistically insignificant, but when we proceed to IV Tobit, it yields a statistically significant estimate suggesting that each additional unit of English

improvement raises the duration for which the immigrant works every week by 6 hours, provided that the immigrant is already working.

The OLS estimates shows improving English speaking ability by one unit brings about 1.29 more years of education. The magnitude of the effect estimated by 2SLS is almost twice as large yielding 2.394 additional years of education. These estimates share basically the same magnitude change as Bleakley and Chin's estimates for the years of schooling variable (2004). Likewise, the 2SLS estimate for the probability of completing tertiary education is also double the size of the OLS estimate. The IV probit estimate further confirms that immigrants who speak one unit better English are over 40% more likely to have completed tertiary studies. Both of these estimates are statistically significant at the 1% level.

In the gender-specific estimation, the results remain largely unchanged; no marked gender heterogeneity has been observed in the effect of language proficiency. That said, male immigrants seem to benefit more in terms of education from having higher competency in English, than female immigrants.

In Table 3, the results of the language effects on social assimilation are presented in the same manner as in Table 2. The OLS estimate for marriage to a native Australian is comparable to that in the US study (Bleakley and Chin, 2004). Whilst the IV approach increases our estimate by five times, it is increased by only three times in their study. The corresponding gender-specific estimates are more or less the same for this dependent variable, while in the US study the increase in the probability of nativity marriage due to language improvement is over 10 percentage points larger for men than for women.

Table 3 The effects of English proficiency on social integration outcomes

Dependent variable	OLS (1)		2SLS (2)		IV probit # (3)	
Full sample						
Married to an Australia-born	0.119***	(0.007)	0.571***	(0.089)	0.795***	(0.084)
Citizen	0.019**	(0.008)	0.108	(0.075)	0.371***	(0.071)
Voluntary work	0.037***	(0.008)	0.027	(0.072)	0.064	(0.075)
Only males						
Married to an Australia-born	0.123***	(0.011)	0.565***	(0.150)	0.772***	(0.143)
Citizen	0.014	(0.011)	0.154	(0.126)	0.400***	(0.121)
Voluntary work	0.034***	(0.010)	-0.018	(0.113)	0.021	(0.119)
Only females						
Married to an Australia-born	0.106***	(0.009)	0.570***	(0.107)	0.830***	(0.102)
Citizen	0.021*	(0.011)	0.079	(0.090)	0.347***	(0.084)

Voluntary work	0.037***	(0.011)	0.055	(0.093)	0.094	(0.096)

*** denotes significance at the 1 % level, ** denotes significance at the 5% level, * denotes significance at the 10% level. # The IV probit estimates are marginal effects. Robust standard errors adjusted for household clusters are shown in parentheses. Each row displays a coefficient estimate of the effect of English proficiency on a different dependent variable.

The IV probit estimate is even larger than the 2SLS and OLS regression results, which suggests that improving language proficiency from "well" to "very well" would lead to an increase of 80% in the likelihood of the immigrant being married to a non-immigrant. Furthermore, voluntary work does not appear to be influenced by language ability changes, as only OLS estimates are statistically significance. Despite the fact that 2SLS shows no statistically significant language effects on both citizenship status and involvement in voluntary work, the IV probit result shows that language improvement contributes to a 37% increase in the likelihood of obtaining citizenship.

In summary, we find strong evidence that better language proficiency leads to better economic outcomes, a higher level of education, and social integration for Australian immigrants. The marginal effects of language skills for Australia are generally larger than their counterparts for the US, which could be explained by the dissimilarity in demographic characteristics of their immigrants as well the way in which employers value migrant workers' language proficiency. In terms of social integration, the likelihood of marriage to a native Australian and of citizenship is increased by better English.

V. Health status, service access, and lifestyle

i. Descriptive statistics

Table 4: Summary statistics of the NHS data

	Total (1)		Very well (2)		Well/not well/not at all (3)	
	Mean	Std Dev	Mean	StdDev	Mean	Std Dev
English-speaking ability	2.963	0.216				
Non-Anglophone country	0.514	0.500	0.497	0.500	1.000**	0.000
Instrument Z	0.734	1.624	0.643	1.511	3.466**	2.367
Outcome variables:						
Self-assessed health	3.523	1.081	3.532	1.079	3.262*	1.093
K10	15.904	6.390	15.839	6.320	17.864**	8.027
No. of LTC	2.654	1.668	2.681	1.665	1.964**	1.588
Visits to GP	0.265	0.571	0.262	0.564	0.349	0.723
Visits to specialists	0.075	0.394	0.076	0.398	0.036	0.244
Regular skin check	0.640	0.480	0.648	0.478	0.417**	0.496
Private health Insurance	0.548	0.498	0.551	0.497	0.437*	0.498
Insurance duration	2.312	2.355	2.337	2.359	1.549**	2.120
Current smoker	0.272	0.445	0.272	0.445	0.272	0.447
Daily alcohol intake	5.838	13.618	5.908	13.732	3.750	9.438
Moderate exercise	1.865	3.335	1.901	3.362	0.777**	2.133
Control variables:						
Age	43.738	10.445	43.883	10.416	9.388**	10.434
Age at arrival	9.137	4.199	9.016	4.160	2.757**	3.732
Male	0.482	0.500	0.484	0.500	0.447	0.500
Years of education	11.776	2.065	11.809	2.051	0.767**	2.224
Personal weekly income	799.599	751.301	809.253	758.536	496.640**	358.492
Number of observations	3195		3092		103	

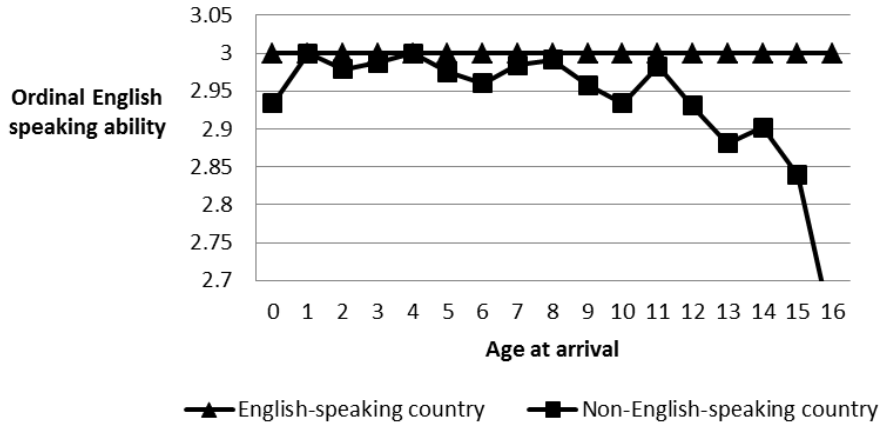
Note: ** denotes significant difference in means at the 1% level compared to the "very well" category; * denotes significant difference in means at the 5% level.

Table 4 provides the summary statistics for the pooled sample and the sub-samples when split into the two proficiency levels – individuals who spoke English "very well" and those who did not. For the purpose of illustration, the three lower fluency units are combined into one. If the individuals only spoke English at home, then they were not required to answer the question about their English speaking ability. And since the sample consists of those who immigrated to Australia at an early age, "very well" is the dominant group. There are only 14 and 1 observations in the "not well" and "not at all" categories respectively. The "well" category has 88 observations and the "very well" has 3,092 observations. Not unlike the 2006 Census data, the slight variation in the language variable would mean that the estimated effect is mostly attributable to the changes from "well" to "very well". The mean of English-speaking ability is 2.963, in comparison to 2.959 from the Census. This is clearly a limitation of this dataset as we are arguably not able to identify the effect of very low language proficiency.

Due to the design of the surveys where respondents are not asked to report their language ability if they only spoke English at home[11], all of the people in the lower proficiency categories are from non-English speaking countries. Immigrants who deemed themselves to have very good language ability reported better general health and a lower score on the Kessler Psychological Distress Scale. They are more likely to have regular skin checkups, private health insurance, be insured for a longer period of time as well as undertake moderate exercise more frequently. However they are inflicted with more long term conditions. In contrast, no statistical difference between these two groups of people is found in the number of visits to a general practitioner or specialist, in the likelihood of being a current smoker, or in the amount of daily alcohol consumption. As expected, a higher age at arrival, more years of education and higher weekly income are associated with those with "very good" spoken English.

[11] It is also reasonable to assume that these people from other English speaking countries are able to speak English very fluently; consequently they are either monolingual or multilingual and can be assumed to have reported "very well" as their English level.

Figure3: Means of English proficiency measure



In Figure 3, English speaking ability is plotted against age at arrival for English-speaking and non-English speaking regions. In spite of more variation in the square-markers line than in Figure 2, we observe a similar downward trend after the age of around 11.

ii. Results

First stage and reduced form results indicates that the instrumental variable significantly influences the English proficiency variable (see supporting information material for the detail of these results).

The OLS, 2SLS are IV Probit estimates of the effect of English speaking skills, are presented first on health outcomes (Table 5); then on lifestyle outcomes (Table 6). Again, each row refers to a different estimation equation with its own dependent outcome variable. The OLS estimates are mostly significant and in agreement with the relationships illustrated in the graphs previously, except for visits to GP and visits to specialists. As we would expect, better language skills lead to better self-perceived health, a better mental faculty, higher probability of having a routine medical check-up, having private health insurance and longer insurance duration. Yet the estimate for long-term conditions is somehow positive. We suspect that this is due to the lack of diagnosis as poorly-spoken immigrants tend not to seek help. However, the effect is not observed in males. Furthermore, language proficiency seems to improve a male's general health and psychological state more than a female's.

Table 5: Effect of English proficiency on health outcomes

	OLS (1)		2SLS (2)		IV Probit[#] (3)	
Full sample						
Self-assessed health	0.253***	(0.087)	0.357	(0.527)		
Kessler 10 score	-1.455**	(0.622)	-3.822	(3.233)		
No. of long-term conditions	0.282**	(0.144)	-0.212	(0.855)		
Visits to GP	-0.085	(0.064)	-0.253	(0.320)		
Visits to specialists	0.020	(0.021)	-0.106	(0.162)		
Regular skin check	0.073*	(0.043)	0.457*	(0.241)	0.441*	(0.234)
Private health Insurance	0.145***	(0.040)	0.271	(0.242)	0.267	(0.248)
Insurance duration	0.748***	(0.160)	1.445	(1.132)		
Only males						
Self-assessed health	0.348**	(0.138)	0.133	(0.935)		
Kessler 10 score	-2.263**	(1.042)	1.042	(5.332)		
No. of long-term conditions	0.204	(0.247)	-1.138	(1.422)		
Visits to GP	-0.039	(0.110)	-0.497	(0.521)		
Visits to specialists	0.045	(0.047)	0.204	(0.280)		
Regular skin check	0.074	(0.064)	0.836*	(0.456)	0.820**	(0.391)
Private health Insurance	0.120*	(0.063)	0.373	(0.429)	0.382	(0.433)
Insurance duration	0.619**	(0.253)	1.999	(1.995)		
Only females						
Self-assessed health	0.218*	(0.114)	0.600	(0.641)		
Kessler 10 score	-0.971***	(0.763)	-4.592	(4.044)		
No. of long-term conditions	0.357**	(0.180)	0.385	(1.093)		
Visits to GP	-0.115	(0.077)	-0.008	(0.418)		
Visits to specialists	0.002	(0.019)	-0.350	(0.214)		
Regular skin check	0.076	(0.058)	0.201	(0.276)	0.155	(0.274)

Private health Insurance	0.166***	(0.052)	0.243	(0.293)	0.238	(0.303)
Insurance duration	0.847***	(0.215)	1.094	(1.386)		

*** denotes significance at the 1 % level, ** denotes significance at the 5% level, * denotes significance at the 10% level. # The IV probit estimates are marginal effects. Robust standard errors adjusted for household clusters are shown in parentheses.

As OLS results are unreliable due to issues that have been stated earlier, we cannot form any causal inferences based on them. We therefore focus on the IV approach. Almost all 2SLS coefficient estimates are statistically insignificant, as shown in column (2), with the exception of regular skin examination. As for the results in the previous section, the 2SLS estimates are higher than OLS estimates with the exception of long term conditions, confirming once again the anticipated downward bias due to measurement error. Each additional proficiency level brings about a 45.7% increase in the likelihood of having regular skin check-up, significant at the 10% level. When each gender is examined separately, it appears that the increase is 83.6% for males, but is insignificant for females at 20.1%. The IV Probit estimates confirm these findings with similar figures to the corresponding 2SLS estimates.

Table 6: The effects of English proficiency on lifestyle outcomes

	OLS (1)		2SLS (2)		IV Probit# (3)	
Full sample						
Current smoker	-0.035	(0.038)	0.075	(0.215)	0.087	(0.224)
Daily alcohol intake	1.595*	(0.828)	-0.569	(6.413)		
Moderate exercise	0.616**	(0.240)	0.531	(1.526)		
Only males						
Current smoker	0.023	(0.064)	0.338	(0.400)	0.362	(0.402)
Daily alcohol intake	2.783	(1.905)	-5.299	(13.795)		
Moderate exercise	1.161***	(0.259)	1.159	(0.259)		
Only females						
Current smoker	-0.071	(0.046)	-0.095	(0.248)	-0.087	(0.257)
Daily alcohol intake	1.705***	(0.533)	-1.674	(4.304)		
Moderate exercise	0.221	(0.362)	-0.013	(1.825)		

*** denotes significance at the 1 % level, ** denotes significance at the 5% level, * denotes significance at the 10% level. # The IV probit estimates are marginal effects. Robust standard errors adjusted for household clusters are shown in parentheses.

The OLS estimates from Table 6 indicate that there is a positive relationship between language proficiency and alcohol consumption, as well as the quantity of moderate exercise. The statistical significance

for these variables of interest is dominated by one gender. In particular, the effect of language on alcohol is only significant for females, whereas the effect of language on physical exercise is only significant for males. The overall effects therefore have diminished p-values when compared to the single-gender effects. However, all the relationships vanish once endogeneity and measurement errors are appropriately addressed in our 2SLS estimations.

In summary, the link between an immigrant's language skills and health related outcomes cannot be firmly established. Given our smaller sample size for the study of health outcomes, it is not clear whether this is due to an absence of effect, or due to the analysis's lack of statistical power.

VI. Conclusion

The study contributes to the literature on the effects of language proficiency in a number of ways. First of all, the novel approach of using the combination of age at arrival and country of origin as an instrument for immigrants' English proficiency has yet to be used in an Australian context. Although such an approach has been used for analysing the situation in the United States, there are discernible differences between the US and Australia in terms of their immigration policy, demographic characteristics of immigrants, multiculturalism policy, and perhaps the general public's attitude towards immigrants. It is these differences which make the research presented here important.

Second, not only has the significance of immigrants' language skills for labour market participation and greater social integration been highlighted by this study, this evidence also leads to exploration of the possibility that the effects of language proficiency could also explain an immigrant's health status, access to health care, private health insurance coverage and health-related lifestyle choices. A number of non-economic studies have shown how limited language proficiency may affect communication between a migrant patient and a medical doctor in terms of comprehension skills and how interpretation services would improve the situation. However, there has been no research using a larger sample size which investigates the association between language proficiency and health.

A limitation of IV estimates is that they are local average treatment effects (LATE); they cannot be treated as average treatment effects (ATE). We would argue that there may be diminishing marginal returns to language learning for immigrants, which then would suggest that the effects of language proficiency could be larger for immigrants in general than they are estimated to be here. Overall then, the findings are especially relevant to skilled immigrants and immigrants who possess a higher degree of language skills.

Knowing the true effects of English language skills is, therefore, the first critical step in implementing the right language policy which, as this study suggests, in turn has the potential to measurably improve the welfare of immigrants and Australia's economy as a whole. It is noted that the importance of improving proficiency through subsidised programs for migrants who are on non-skilled types of visa may well have

been understated given OLS models were producing downward biased estimates of the direct language effects. And although significantly improving immigrants' language outcomes seems to be easier and more cost effective when they are still young children, our analysis indicates it is still necessary to ensure adequate funding is allocated to language learning programs for adult immigrants with low levels of fluency.

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